Hall, not only gave up the use of his yacht for the summer in the cause of Science, but bore nearly the whole expense of the cruise himself. The naturalist who accompanied them was Mr. Kent, of the British Museum, a man comparatively unknown before that time; and this was, perhaps, the reason why the Royal Society could only afford to give £50 towards the expense of apparatus, &c. As a natural consequence, the expedition was considerably crippled for want of proper gear, and they were unable to attempt deep-sea work. It is too rare for persons who are blessed with means to assist Science in any way, and when such an act of generosity does take place, it ought not to be forgotten on the part of the scientific public. Yet it is rumoured that a similar expedition to Morocco and Madeira, which Mr. Marshall Hall is arranging for the spring, is likely to be received with some coldness by some influential members of the scientific brotherhood. We sincerely hope that the rumour is incorrect.

It appears that Mr. Marshall Hall proposes to be absent from England for between three and four months; and, besides the natural history, to investigate, as far as possible, certain chemical and physical questions concerning the deep sea and its currents in the neighbourhood of the above-mentioned places. He is taking with him a young naturalist, Mr. P. T. Abraham, B.A., B.Sc., lately from Dublin, at which University he came out first in natural science honours, and where he has gained a high reputation for zoological knowledge. It is also probable that another naturalist will make up the staff. These gentlemen intend to give, besides the use of the yacht, 150*l.* or so—as much as they are able. The remaining 250*l.*—for the total cost of the expedition could not amount to much less than 400*l.*, when the items of gear, apparatus, outfit, and maintenance for such a time are taken into consideration—they hope to obtain in the form of grants from the learned societies. We feel sure that the Royal Society will be among the first to endow the work out of the fund placed at their disposal by the Government, and the best friends of Biology may wish that they had more frequent opportunities afforded them of assisting in researches in which it is fitting that in the first instance a private individual should come forward.

It is possible even that other societies may be induced to help if they have funds at their disposal. Among such societies we may mention the Zoological Society, which contains on its roll the names of men of the first rank in every department of zoology. It is true that a great portion of the funds are expended in the direction of the higher vertebrates, and that the lower animals do not receive the attention they may deserve; but still, it must be remembered that the great object of the society is the popularisation of natural history.

We hope that the *Norna's* will not be the only dredging excursion starting from British waters this year. The field that has been so ably opened up by Dr. Carpenter and his colleagues ought not to be allowed to slip away altogether from the hands of Englishmen. We know too well that other nations are not backward in following up and eclipsing the work that British pluck and genius have been the first to venture upon. The Americans are on the track, and our Continental neighbours will not be far behind.

We are glad that the extended circumnavigation expedition is in process, and we believe that if nothing unforseen occurs, Prof. Wyville Thomson, with a staff of competent aids, will sail in the autumn on their long journey, which cannot fail to have the most important bearing on our future advance in such studies. Such a journey as this, however, instead of making more modest dredging operations of no avail, vastly increases their importance; and it is not too much to hope that the time is not far distant when men of money and leisure will more generally occupy their time in such pursuits.

SOLAR HEAT

THE calculations presented by Père Secchi, in his work "Le Soleil," relative to solar temperature and solar radiation, tending to discredit the result of recent investigations on the subject, I have carefully examined the "solar intensity apparatus," the indications of which form the basis of those calculations. This unique device will be found delineated on p. 267 of the work referred to, the accompanying illustration (Fig. 1) being a fac-simile of the same. It represents a longitudinal section through the centre line, thus described:—A B and C D are two concentric cylinders soldered one to the other; they form a kind of boiler, the annular space being filled with water or oil at any temperature. A thermometer, *t*, passes through a tube, across the annular space, to the axis of the cylinder; it receives the solar rays introduced through a diaphragm, *m n*, the opening, *o*, of which is very little larger than the bulb of the thermometer. A thick glass, V, closes the back part of the instrument, and admits of ascertaining whether the thermometer is placed in a direct line with the pencil of rays. The interior cylinder and the thermometer *t* are coated with lamp black. A second thermometer, *t'*, shows the temperature of the annular space, and consequently that of the inclosure. The whole apparatus is mounted on a support having a parallactic movement, to facilitate following the diurnal motion of the sun. The apparatus being exposed to the sun, it will be found, on observing the two thermometers, that their difference of temperature increases gradually, and that in a short time it ends by being constant.

Before pointing out the peculiarities of the contrivance thus described by Père Secchi, it will be instructive to examine his "solar intensity apparatus," manufactured by Casella, represented in Fig. 2. The manufacturer publishes the following statement regarding this instrument:—"Two thermometers are here kept immersed in a fluid at any temperature, and a third surrounded by the same conditions, but not immersed, is exposed to the rays of the sun. The increase of temperature thus obtained is found to be the same, irrespective of the temperature of the fluid which surrounds it." No one acquainted with the principles which govern the transmission of heat within circulating fluids can fail to observe that the thermometers applied above the central tube will not furnish a reliable indication of the temperature of the fluid below the same, nor of any portion of the contents of the annular space towards the bottom. Apart from this defect, it will be perceived that an upward current of atmospheric air will sweep the underside of the external cylinder, causing a reduction of temperature of the fluid confined in the lower half of the annular space. Again, the heat radiated by the bulb of the thermometer exposed to the sun will elevate the temperature of the air within the central tube, and consequently produce an internal circulation tending to heat the upper part of the fluid contained in the annular space. The effect of the irregular heating and cooling thus adverted to will be considered after an examination of the result of some observations recorded in Table A conducted at different times during the month of September 1871. In order to insure an accurate position, the instrument during these observations was mounted in a revolving observatory upon a table turning on declination axes provided with appropriate mechanism and declination circle. An actinometer being attached to the same table, the true intensity of the radiant heat, as well as the sun's zenith distance, were recorded simultaneously with the indications of the Secchi instrument furnished by Casella. Let us first consider the tabulated observations of September 2 recorded at equal intervals of three minutes. The indication of the two thermometers immersed in the fluid contained in the annular space first claims our attention, since the temperature of this fluid is the principal element in Père Secchi's computations of solar temperature. It will be seen on referring to the second and third columns of the table that, while the upper thermometer indicates a mean temperature of 86·9,° the lower one shows only 79·5°, difference = 7·4°. This great discrepancy of temperature at different points of the upper portions of the annular space at which, owing to the inclined position of the concentric tubes, something like uniformity ought to exist, suggests a still greater discrepancy of temperature at the underside towards the lower termination of the tubes. In addition therefore to the observed irregularity of temperature at the upper part, shown by the table, no indication whatever is furnished of the temperature of the fluid in the annular space below the central tube, nor towards the termination at either side. Obviously, then, no accurate computation can be made of the degree of refrigeration to which the central thermometer is exposed by the radiation from the cold blackened surface of the internal tube, every part of which, as we have seen, possesses a different temperature compared with the rest, consequently transmitting radiant energy of different intensity. It will be found practically impossible, therefore, to determine the true differential temperature of the contents of the bulb exposed to the sun's rays and the fluid contained in the annular space. Hence, the differential temperature entered in the table, the result of comparing the indications of the thermometers, is manifestly incorrect. It will be found also by reference to the table that while the mean temperature imparted to the central thermometer by the sun's rays is 93·1°, the mean temperature of the fluid in the annular space is 83·3°. Consequently, the intensity of solar radiation established by the instrument is only 93·1° − 83·3° = 9·79° Fah. Now, the sun during the recorded experiment of September 2 was exceptionally clear, the mean indication of the actinometer while the experiment lasted being 60·05°, thus showing that the energy developed was only $\frac{9{\cdot}79}{60{\cdot}05} = 0{\cdot}16$ of the true radiant intensity. The mean zenith distance, it may be mentioned, was only 33° 24′ during the experiment. Agreeable to the table of temperatures previously published, the maximum solar intensity for the stated zenith distance is 63·35°; thus we find that the sun, as stated, was exceptionally clear while the trial took place, which resulted in developing the trifling intensity of 9·79° Fah. The result of the experiments conducted September 6th, recorded in the table, it will be seen was nearly the same as that just related, the mean temperature indicated by the thermometer exposed to the sun being 98·2°, while the mean of the two thermometers immersed in the fluid was 87·8°, hence the differential temperature 98·2° − 87·8° = 10·4°. The mean temperature of solar radiation during the experiment, ascertained by the actinometer, was 59·75°, the zenith distance being 35° 33′. Consequently, the intensity indicated September 6th was only $\frac{10{\cdot}45}{59{\cdot}75} = 0{\cdot}17$ of the true energy of the sun's radiant heat, against 0·16 during the previous experiment. It will be observed that the fluctuation of the differential temperature was much greater September 2nd than during the succeeding experiment, owing, no doubt, to the influence of currents of air produced by a strong breeze on the first occasion, the revolving observatory being partially open on the side presented to the sun during observations.

With reference to the small differential temperature indicated by the Secchi instrument manufactured by Casella, it may be urged that it is not intended to show the true intensity of solar radiation on the earth's surface, but simply a means of determining solar temperature. Granted that such is the object, yet the extreme irregularity of the temperature of the fluid within the annular space shows that the instrument is unreliable, a fact established beyond contradiction by an experiment instituted September 27, 1871. On this occasion water of a uniform temperature was circulated through the annular space. This was effected by gradually charging this space from the top, and carrying off the waste at the bottom, holes having been drilled in the external casing for that purpose. The result of this conclusive experiment is recorded at the foot of Table A. It will be found on reference to the figures, that the mean difference of the two thermometers immersed in the fluid was only 64·9° − 64·4 = 0·5°, while the mean differential temperature was augmented to 79·1° − 64·45 = 14·65° against 9·79° on the 2nd of September, although the zenith distance was greater, and the solar intensity less; circumstances which ought to have *diminished* the indicated intensity. It is needless to enter into any further discussion of the demerits of the instrument represented in Fig. 2. We may now return to the consideration of the device delineated in Fig. 1, copied from "Le Soleil." It will be seen that the material difference of construction is that of applying only one thermometer for ascertaining the temperature of the fluid in the annular space. Possibly this single thermometer may indicate approximately the mean temperature of the upper and lower portions of the fluid above the central tube; but it furnishes no indication of the temperature below, nor at either extremity of the annular space. The inadequacy of the means adopted for ascertaining the temperature of the internal surface which radiates towards the bulb of the central thermometer having thus been pointed out, it will be well to consider whether the expedient of passing a stream of water of nearly uniform temperature through the annular space, will insure trustworthy indication. In order to determine this question, I have constructed two instruments, in strict accordance with the delineation in Fig. 1, excepting that in one of these the concentric cylinders are considerably enlarged, the annular space, however, remaining unchanged. Experiments with the two instruments prove that the enlargement does not materially influence the indications, provided water of a uniform temperature be circulated through the annular space. But these experiments have demonstrated that the size of the bulb of the thermometer exposed to the sun cannot be changed without influencing the differential temperature most materially. This will be seen by reference to Table B, which records the result of experiments with different thermometers, and tubes of different diameter, conducted October 17, 1871. As on previous occasions, the instruments, in order to insure accurate position, were attached to the declination table arranged within the revolving observatory. The bulbs of the thermometers employed were very nearly spherical, their diameters being respectively 0·30 and 0·58 ins. The upper division of Table B which records the experiment with the *small* bulb exposed to the sun, establishes, it will be seen, a differential temperature of 14·4° for the instrument having the 1¼-in. central tube, and 16° for the one having the 3-in. central tube. Referring to the lower division of the same table, it will be seen that when the thermometer with the *large* bulb is exposed to the sun, the differential temperature reaches 22·5° in the instrument containing the 1¼in. central tube, and 21·1° in the one having the 3in. tube. We thus find that, by doubling the diameter of the bulb of the thermometer exposed to the sun, all other things remaining unchanged, an augmentation of the differential temperature amounting to nearly one-third takes place. This fact proves the existence of inherent defects fatal to the device delineated in Fig. 1, rendering the same wholly unreliable.

Agreeably to the doctrine of exchanges, the diameter of the bulb is an element of no moment, since the internal radiation towards the same—*provided its temperature be uniform*—depends solely on the temperature and angular distances of the radiating points of the enclosure. Infallibility of the "solar intensity apparatus" has evidently been taken for granted on the strength of the soundness of this doctrine, as we find no allusion to the size of the bulb in M. Soret's account of his observations of solar intensity on Mont Blanc; nor does Mr. Waterston, who employed a similar instrument during his observations in India, advert to the dimensions of the bulb of the thermometer exposed to the sun. These physicists apparently overlook the fact that, while the entire convex area of the bulb is exposed to what may be considered the cold radiation from the enclosure, only one half receives radiant heat from the sun. This circumstance would be unimportant if the heat thus received were instantly transmitted to every part; but the bulb and its contents are slow conductors, while the conducting power diminishes nearly in the inverse ratio of the square of the depth. Consequently, by increasing the diameter, the parts of the bulb opposite to the sun will receive considerably less heat in a given time than if the diameter be diminished.

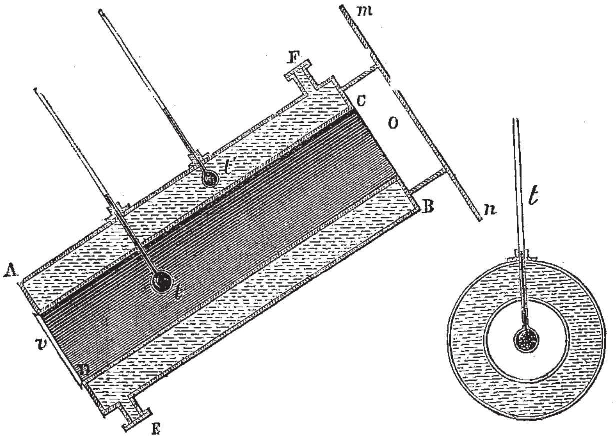


FIG. 1.

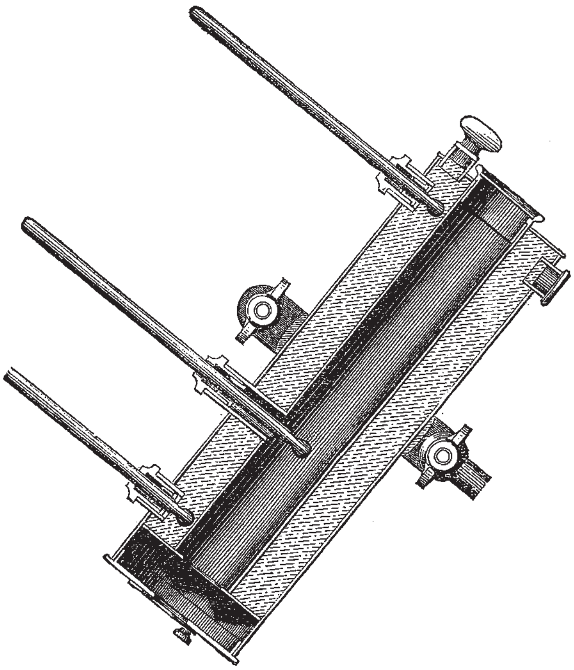


FIG. 2.

TABLE A, showing the result of observations made with Secchi's "Solar Intensity Apparatus," manufactured by Casella.

Thermometer exposed to the Sun.	External Casing. Upper Thermometer.	External Casing. Lower Thermometer.	External Casing. Mean.	Differential temperature.	Zenith distance.
SEPTEMBER 2, 1871.					
Fah.	Fah.	Fah.	Fah.	Fah.	° ′
83·5	76·0	70·0	73·0	10·5	33 0
84·2	77·0	71·5	74·2	10·0	
85·5	79·0	74·2	76·6	8·8	32 50
86·0	83·5	74·5	79·0	7·0	
89·0	84·0	75·5	79·7	9·2	33 0
90·5	85·0	76·5	80·7	9·2	
92·0	85·5	78·0	81·7	10·2	33 10
93·0	86·5	79·0	82·7	10·2	
94·0	87·8	80·0	83·9	10·1	33 21
94·5	89·0	81·5	85·2	9·2	
95·5	90·0	82·5	86·2	9·2	33 32
96·5	90·5	83·5	87·0	9·5	
98·0	91·5	84·5	88·0	10·0	33 44
99·0	92·0	85·0	88·5	10·5	
100·0	93·0	86·0	89·5	10·5	33 56
101·0	93·5	86·5	90·0	11·0	
101·5	94·0	87·0	90·5	11·0	34 8
93·1	86·9	79·5	83·3	9·79	33 24
SEPTEMBER 6, 1871.					
94·5	88·0	81·5	84·7	9·7	35 56
95·5	88·5	83·0	85·7	9·7	
96·5	89·5	84·5	87·0	9·5	35 41
97·5	90·0	85·0	87·5	10·0	
98·0	90·0	85·0	87·5	10·5	35 26
98·5	90·5	85·5	88·0	10·5	
99·0	90·5	85·7	88·1	10·9	35 11
100·0	91·0	86·5	88·7	11·2	
100·3	91·0	87·0	89·0	11·3	34 56
100·3	91·2	87·5	89·3	11·0	
100·5	91·5	88·0	89·7	10·8	34 41
98·2	90·2	85·3	87·8	10·45	35 33
SEPTEMBER 27, 1871.					
78·5	64·0	64·0	64·0	14·5	44 0
79·0	65·0	64·0	64·5	14·5	
79·5	65 0	64·5	64·7	14·7	44 55
79·5	63·0	65·0	64·0	15·5	
79·5	64·0	65·0	64·5	15·0	45 51
79·0	64·5	65·0	64·7	14·2	
79·0	64·5	65·5	65·0	14·0	46 48
79·0	64·5	65·5	65·0	14·0	
79·0	65·0	65·5	65·2	13·8	47 46
79·1	64·4	64·9	64·65	14·45	45 16

TABLE B, showing the result of employing different thermometers.

Diameter of Bulb 0·30 in.

1¼ inch tube. Sun.	1¼ inch tube. Fluid.	1¼ inch tube. Diff.	Zenith distance.	3 inch tube. Sun.	3 inch tube. Fluid.	3 inch tube. Diff.	Zenith distance
Fah.	Fah.	Fah.	° ′	Fah.	Fah.	Fah.	° ′
74	60	14	50·32	77·5	62·1	15·4	49 54
74·5	60·3	14·2	50·24	78·5	62·3	16·2	50 3
75	60·7	14·3	50·16	79	62·5	16·5	50 12
75·5	61	14·4	50·8	79	63	16	50 21
76	61	15	50·1	79	63	16	50 30
75·0	60·6	14·4	50·16	78·6	62·6	16·0	50 12

Diameter of Bulb 0·58 in.

1¼ inch tube.			Zenith distance.	3 inch tube.			Zenith distance
Sun.	Fluid.	Diff.		Sun.	Fluid.	Diff.	
Fah.	Fah.	Fah.	° ′	Fah.	Fah.	Fah.	° ′
83·6	62·6	21	49 54	79·2	60·1	19·1	50 32
85·5	63	22·5	50 3	81	60·3	20·7	50 24
86·4	63·4	23	50 12	82·5	60·7	21·8	50 16
86·7	63·5	23·2	50 21	82·7	60·7	22	50 8
87·7	63·7	23	50 30	83	61	22	50 1
85·9	63·2	22·5	50 12	81·7	60·6	21·1	50 16

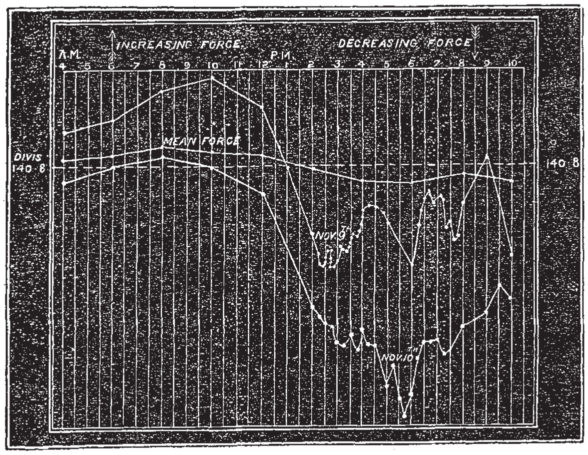
J. ERICSSON

MAGNETICAL AND METEOROLOGICAL OBSERVATIONS AT HAVANA

ON the 9th and 10th day of November I noticed on my instruments two strong magnetic perturbations, during which a series of extraordinary observations was taken at intervals of five, of ten, and fifteen minutes. From these I was naturally drawn to think that an aurora borealis would be seen in higher latitudes, and was waiting for a confirmation of my views.

This I found in the numbers 16th and 23rd of November of your scientific journal, NATURE, which I have just received, and in which I see with great pleasure the description of the aurora borealis seen in England on the 9th and 10th of November in perfect accordance with my observations of those days.

Curves of the Horizontal Magnetic Force on the 9th and 10th days of November, 1871, compared with the Mean Force of the whole month.



SCALE { 1 *hour* = 0^{m} ·01 *in the line of the abscissæ*
5 *division of the scale of the Bifilar Magnetometer* = 0^{m} ·01 *in the line of the ordinates.*

Each one of these divisions of the scale corresponds in parts of horizontal force to K = 0·000099573.

As it will not be devoid of interest to know to what an extent an aurora borealis, when seen in England, exerts its influence on the magnetic variations of a place situated in the Tropics and in very remote longitude, I take the liberty of sending you the curves of the horizontal magnetic force as registered by the bifilar magnetometer on the 9th and 10th of November, together with the curve of the mean horizontal force of the whole month. A comparison between them and those taken in other places will be, I hope, very pleasant to those who are interested in magnetic researches.

My observations on the bifilar magnetometer are reduced to the temperature of 77° Fah. The variation of the thermometer attached to it was 0°·8 during the whole perturbation.

The magnetic instruments I make use of are those of the Observatory of Makerston, Scotland, which were arranged and sent many years ago to this Observatory by order of General Sabine at the request of P. Secchi, of the Roman Observatory.

Another perturbation, although not so intense as those already described, was observed on the 2nd of November. It began at ten o'clock in the morning, and lasted the whole day.

A very remarkable one was also observed on the 17th and 18th of June; it began at ten o'clock in the evening of the 17th.

On the 21st of August, while a hurricane was felt in St. Thomas, and an aurora borealis seen from the Observatory of Dun Echt, Aberdeen, I noticed an extraordinary variation, which attained its maximum between four and six o'clock in the afternoon. A similar one occurred on the 24th.

Finally, on the 16th and 17th of August two great hurricanes swept the shores of Florida, and their influence upon the magnetic force can be perfectly noticed on the curves of those days.

BENEDICT VINES

Havana, Dec. 21, 1871

NOTES

WE alluded some time since to the threatened destruction of one of the most notable megalithic monuments in this country, the Great Circle at Avebury, in Wiltshire. All archæologists will be glad to hear that Sir John Lubbock has added one more to his eminent services to science by the purchase of the site on which the Circle stands. It is right also that the meed of praise should be awarded to those of the residents in the district whose zeal has been directed towards the attainment of this object; and who have thus shown their sense of the value of the monument which is one of the glories of their county. We refer especially to the Rev. Bryan King, the vicar of the parish, Mr. Kemm, Mr. George Brown, and the Rev. Alfred Charles Smith, Hon. Secretary of the Wiltshire Archæological and Natural History Society. It is to be hoped that their example will stimulate similar zeal for the preservation of monuments in other parts of the country.

DR. T. STERRY HUNT, chemist to the Canadian Geological Survey, has been appointed to the chair of Geology in the Massachusetts Institute of Technology.

MR. HENSMAN has been appointed Lecturer on Botany at the Middlesex Hospital, in the place of Dr. T. S. Cobbold, F.R.S., who has received the appointment of Lecturer on Parasitic Diseases.

AT the meeting of the Royal Geographical Society on Monday evening last, Sir Henry Rawlinson, the President, announced that the vessel with the Livingstone Expedition on board arrived at Malta on the 23rd inst., and was to reach Port Said on Sunday, and leave Suez on Monday night. By the accounts to hand all on board were pronounced to be well, and in the highest spirits. The finances of the expedition were in a highly satisfactory state, many contributions being remarkably striking, as showing the great interest taken in the enterprise not only in this, but in many distant countries. A contribution of 100 guineas had been received from a former member at Stockholm, who had always taken a deep interest in the travels and discoveries of Dr. Livingstone. The Italian Royal Geographical Society had also sent a contribution of 15*l*. 15*s*., while national committees to assist the fund had been formed in Scotland and Ireland, who were working most energetically. The town of Glasgow has subscribed 1,000*l*., Edinburgh 400*l*., and Dublin promised to be equally